RISK ANALYSIS RELATED TO OPERATIONS IN OIL AND GAS PLANT: THE CHALLENGES FOR QUANTITATIVE AND QUALITATIVE ANALYSIS

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ABSTRACT

This research is related to the circle of risk management in an oil and gas industry which only discussing the items with regards to risk analysis phase only instead of embedded up to whole of phases in the managing risk. In this industry, there are onshore and offshore sectors. Additionally, the scope of this research is only covering the plant in onshore sites. This research is conducted as there are several flaws or weaknesses in analyzing risks in the onshore plant. These weak points caused the risk analysis done previously seems relatively not effective since there is still accident happened in the plant. Therefore, this research was carried in order to search out what are the challenges that contribute to the existence of those flaws. This research was also done to determine the types of risks that have high possibilities to take place in undesirable future condition as well as investigating the types of risk analysis practiced by the personnel in analyzing these risks. The scope of this research is not over than the states of Pahang and Terengganu in the East Coast region of Malaysia. By referring to the previous academic sources, the term “risk” itself could brings either positive of negative definition. In the nature of risk, there are sequences of risk attitude when dealing with risk. The major types of risk attitude are risk averse, risk neutral and risk acceptance. The sources also discussed on the operations of the oil and gas plant as well as the types of risks identified that related to those operations. The most important parts of the information are the knowledge of the types of techniques used to analyze risk such as FMEA and HAZOP as well as the challenges that have been identified in conducting risk analysis in other industries generally. The type of sampling method used in this research was the simple random sampling which is the most suitable method to choose the targeted samples. By thorough discussions on the findings, there are five major types of risks exist in the onshore oil and gas plant which are fire, explosion, gas and equipment or machinery risks as well as maintenance risk. There are more than one type of risk analysis technique practiced in the plant such as the HAZID, HAZOP, FMEA, fault tree analysis and the HIRARC. Moreover, this research highlighted four specific challenges faced during the risk analysis process like limited of data, optimistic estimating, complex measurement and communication of risks and last but not least interpreting past data to predict or make decision of future risks.

ABSTRAK

Kajian ini adalah berkisar tentang sekitar pengurusan risiko dalam industri minyak dan gas di mana membincangkan perkara-perkara yang berkaitan dengan fasa analisis risiko sahaja dan bukan sehingga keseluruhan fasa dalam pengurusan risiko. Dalam industri ini, terdapat sektor dalam dan luar pesisir . Selain itu , skop kajian ini hanya meliputi loji atau kilang di tapak daratan. Kajian ini dijalankan kerana terdapat beberapa kelemahan atau kelemahan dalam menganalisis risiko dalam loji daratan. Hal ini disebabkan oleh analisis risiko yang dilakukan sebelum ini seolah-olah agak tidak berkesan kerana masih terdapat kemalangan yang berlaku di kilang atau loji. Oleh itu, kajian ini dijalankan untuk mencari apakah cabaran yang menyumbang kepada kewujudan kekurangan tersebut. Kajian ini juga dilakukan untuk menentukan jenis risiko yang mempunyai kemungkinan tinggi untuk mengambil tempat dalam keadaan yang tidak diingini pada masa depan selain menyiasat jenis analisis risiko yang diamalkan oleh kakitangan dalam menganalisis risiko-risiko ini . Skop kajian ini tidak lebih daripada negeri Pahang dan Terengganu di kawasan Pantai Timur Malaysia. Dengan merujuk kepada sumber-sumber akademik lepas, istilah " risiko " itu sendiri boleh membawa sama ada positif definisi negatif. Dalam sifat risiko , terdapat urutan sikap risiko apabila berurusan dengan risiko. Tiga jenis sikap risiko utama iaitu mengambil risiko , risiko neutral dan penerimaan risiko. Sumber-sumber tersebut juga memberi maklumat mengenai operasi kilang minyak dan gas dan juga jenis-jenis risiko yang dikenal pasti yang berkaitan dengan pengendalian itu . Bahagian maklumat yang paling penting adalah pengetahuan jenis teknik yang digunakan untuk menganalisis risiko seperti FMEA dan HAZOP serta cabaran-cabaran yang telah dikenal pasti dalam menjalankan analisis risiko dalam industri lain secara amnya. Jenis kaedah persampelan yang digunakan dalam kajian ini adalah pensampelan rawak mudah yang merupakan kaedah yang paling sesuai untuk memilih sampel sasaran. Dengan perbincangan yang menyeluruh ke atas hasil kajian, terdapat lima jenis utama risiko wujud dalam kilang minyak dan gas daratan iaitu kebakaran, letupan , gas dan peralatan atau risiko jentera dan risiko penyelenggaraan. Terdapat lebih daripada satu jenis teknik analisis risiko diamalkan di kilang seperti HAZID itu, HAZOP, FMEA , analisis pokok dan HIRARC. Selain itu , kajian ini mengetengahkan empat cabaran tertentu yang dihadapi semasa proses analisis risiko seperti data yang terhad, anggaran yakin, ukuran dan komunikasi risiko yang kompleks serta penggunaan data yang lepas.

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LIST OF ABBREVIATIONS

FMEA	Failure Modes and Effect Analysis
FTA	Fault Tree Analysis
HAZOP	Hazard and Operability Study
HAZID	Hazard Identification Study
HIRARC	Hazard Identification, Risk Assessment and Risk Control
HRA	Hazard and Risk Assessment
PETRONAS	Petroliam Nasional Berhad
PPE	Personal Protection Equipment
PPIC	PETRONAS Petroleum Industry Complex
PRA	Probabilistic Risk Assessment
SPSS	Statistical Packages for Social Sciences
SWIFT	Structured What-If Technique

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

An oil and gas industry is one of the industries which contribute to an economic of growth of a country. Globally, as the industry is giving huge money cash flows and defined as “gold field”, most of places specifically in the ocean region are explored and opened for oil and gas drilling activities. Significantly, the oil and gas industry is constituted of upstream, midstream and downstream activities which had been determined their respective hazards and risks. The operations in this industry for both offshore and onshore sites are in contact with dangerous circumstances including the presence of hazardous chemicals and the complex, critical equipments in the plant. By relying on this condition, it can be said that the oil and gas industry is non-zero risks and non-free hazard industry.

Malaysia is one of the places which is found as the precious area which having this industry in its coastal regions such as Terengganu and Pahang. In order to cope with the unsafe working situation, there are several legislations and acts that had been outlined by the government related agency with regards to occupational safety and health criteria. For industry in Malaysia, the Department of Occupational Safety and Health (DOSH) is the body assigned by the Malaysian Government to control the rights of the employees regarding to their safety and health. Particularly, the acts or regulations practiced in for the oil and gas industry are Occupational Safety and Health Act 1994 (OSHA), Control of Industrial Major Accident Hazard (CIMAH) law, Petroleum (Safety Measures) Act 1984 as well as Factory and Machinery Act (FMA) summarized the needs and procedures that crucial to be undertaken by industries including petroleum industry to have specific risk management in the plant, (Hafsham, 2007).

Complying with the stated regulations and legislations, it is compulsory for oil and gas companies to carry out risk analysis or assessment of the risk that presents in the onshore and offshore oil and gas plant. The rationale of conducting the risk analysis is so that the risk management process that a company should apply can be comprehensively prepared and followed by the plant personnel. In addition, the identified risk can be well analyzed its possibilities of occurrence along with its level of seriousness and give much closer of true picture on the real dangerous situation in plant especially to those which related with operations run in the particular plant. Besides that, the risk analysis can help in producing a detail document on the assessed risk and therefore can be reference if there is any accident happens in the plant or workshop in future time.

The onshore plant's projects are as dangerous as the projects carried out in offshore platform. The activities are highly contact with hazards and risks, hence, the risk analysis should be done as comprehensive as that is done for the operations of the offshore activities. The process of analyzing risk should be from the very first operation started in the plant until the last operation. This process is to ensure that the potential risk is assessed as much as possible without overlooking any operations in the plant and since the operations in the plant are unique and differ to each other, every single operation in the plant must be analyzed its possible risk and the results of the analysis must not be used for whole future time because the operations might have undergone either small or big changes in its procedures and the equipment may be also changed. For that reasons, the risk analysis must be carried out in the plant routinely and not stop for one time only.

In analyzing risk, the methods that can be practiced to analyze the risks for each operation may vary due to the equipment used in the plant which also can differ to each other. Only one method of risk analysis used to analyzed equipment is sometimes not suitable to assess its risk because one method of analyzing the risk can be only up o certain aim or objective. For an example, the FMEA is used to analyze risk of the equipment failure while the HAZID is more to only identify risk in the plant. Consequently, more than one type of risk analysis should be used at one time so that the risk in the plant is analyzed extensively and well discovered. Lastly, in order to have good risk analysis, the method used must be both qualitative and quantitative methods so that the risk analysis document is not only about the description of the risk.

1.2 PROBLEM BACKGROUND

Risk analysis is the method or technique to assess identified risk and it is one of the chain of risk management process. According to Kouns and Minoli (2011), the term “risk analysis” can be also replaced by other similar term which is “risk assessment” whenever necessary. Thus, the usage of these two terms can be interchange throughout the discussions of this research. This research specifically related to oil and gas industry.

Based on previous record, many accidents or injuries happed in this industry. As pointed by Jamin (2012) in his column, there were nine workers injured and one killed in the case of a gas processing plant exploded in Kerteh, Terengganu. The accident may due to the incomplete or incomprehensive risk analysis done for the plant operations particularly.

Additionally, the accident also due to management fault or from the mistakes that had been done by the workers themselves. It is understood that there are some weakness during the process of analyzing risk in the plant. This study will be carried out to find out the challenges faced during analyzing the risk in onshore plant so that the flaws that weaken the risk analysis process can be resolved in future.

1.3 PROBLEM STATEMENT

An oil and gas industry consists of onshore and offshore sectors. In this industry, either onshore or offshore is described and observed as non zero-risk industry. In onshore oil and gas plant, there are risk analyses which used or carried out to cater its risky surrounding. Every single risk analysis done is hopefully able to minimize the number of accidents and to some extent could minimize the risks in plant. Nevertheless, these risk analyses have flaws and disadvantages to conduct, for instances, vast number of methods to use in an assessment of risks, involvement of people in the plant is not considered as a whole in doing risk analysis and problem to search out the factors contributing to undesirable operating condition.

The huge number of methods in theory is one of the issues in carrying out an assessment of risks. As outlined by Aven (2008), there are so many approaches that are used in assessing risks. In his book, the author had come out with several types of risk analyses like FMEA, HAZOP and SWIFT techniques. On the other hand, it had been discussed that there are several forms of risk assessment tools that can be used in

analyzing risks such as FTA, HRA and PRA and these three are used in its own traditional way, (Ostrom and Wilhelmsen, 2012). These two arguments prove that there numerous methods may present along the process of analyzing risk.

An involvement of specific people in conducting risk analysis also weakens the effectiveness of the analysis. According to Calixto (2013), the collection of data and the breakdown of the historical data assessment should be part of operations and its maintenance routines, plus it should be identified and supported by the managers. As illustrated by Lund et al. (2010), in the process of analyzing risks, the only the analysis team with the participation by major or domain roles such as the representatives of each department is required to involved along the process.

The last problem is searching out the factors that contribute to the undesirable conditions in the complex systems and operations in the plant. As pointed by Ayyub (2011), it is a challenge to recognize or discover the vulnerable reasons that lead to a disagreeable and an unacceptable operating state in the assessment and analysis of the risks regarding to the complex systems.

Collectively, these statement of problems with regards to the risk assessment are the weakening the effectiveness of the risk analysis itself. Therefore, this research will be going to increase the effectiveness of the process of analyzing risks as this research is intended to investigate the challenges of conducting risk analysis in the onshore oil and gas plant so that related direction will be obtained towards solving the problems mentioned earlier.

1.4 RESEARCH OBJECTIVES

1) To identify types of risk that are high probably present in onshore oil and gas plant.
2) To investigate types of risk analysis practiced for operations in onshore oil and gas plant.
3) To analyze the challenges in conducting risk analysis for operations in onshore oil and gas plant.

1.5 RESEARCH QUESTIONS

R.O 1:

1) What are the operations carried out in the oil and gas plant?
2) What are the risks that are high possibilities to take place in the plant?

R.O 2:
1) What are the types of risk analysis used specifically used for the operations in oil and gas plant?
2) Who prepare or carry out the risk analysis for the operations in oil and gas plant?

R.O 3:
1) What are the processes involve in conducting the risk analysis?
2) What are the elements in the risk analysis process?
3) What are the challenges faced by the risk analyst in developing the risk analysis for operations in oil and gas plant?

1.6 SCOPE AND LIMITATIONS OF RESEARCH

This research will cover the operations in onshore oil and gas plant in the East Coast region of Malaysia which are mainly in Kerteh and Telok Kalong in Terengganu as well as Gebeng in Pahang. The state of Kelantan will be not included.

The plant involve is either involve only PETRONAS plant or some other plant or workshop which belongs to other oil and gas company. In addition, the companies that are planned to be approached could be client, service provider or fabricator as long as the companies are doing business or service for oil and gas plant. There will be no companies that are doing business other than related to oil and gas filed such as companies in construction industry.

This research is involving those workers and management in the oil and gas plant who work for projects undertaken in onshore section. The population for the research will not be those who work at offshore oil and gas platforms.

The type of risk analyses for both qualitative and quantitative methods will be considered. However, the risk analyses used in the selected oil and gas plant are only listed with brief description and not on explaining how the risk analyses formulated from the beginning.

This research is conducted within limited time. The survey that will be carried out within 3 months time and the data collection are going to be done in the time as stated earlier. The results may not be easily collected if the targeted people are not in place during the data collection. It is expected to gain better results if the time given for this research is longer than existence one as more respondents can be approached for the survey.

1.7 SIGNIFICANCE OF STUDY

This research is conducted in order to clarify what are the problems with the existence risk analysis as there is accident happen in the plant by searching the challenges that need to be faced by the risk analyst during the development of the risk analysis which may cause the analysis to be less accurate or less effective.

Hence, by doing this research is hopefully able to assist the risk analyst to improve their methods in conducting the risk analysis. The challenges which will be outlined at the end of this research can be reduced in future by finding ways to mitigate them. Additionally, it is also expected to help those people who work at the operations section to realize their unrealized act or behavior which may lead to accident to occur.

1.8 EXPECTED RESULTS

There are three major risks will be determined through this research. They are fire and explosion risks as well as gas risk. The expectation is based on the nature of the oil and gas industry itself. At the end of this research, there might be more than these types of risk that are having high possibilities to occur in the onshore plant.

Next expected result will be related to second research objective. It is predicted that there are variety methods used in the process of analyzing risk in the plant. The popular technique such as HAZOP is expected to be one of the methods implemented during the process.

It is highly expected that the barriers or challenges in carrying out both qualitative and quantitative risk analysis for the operations in oil and gas plant will be identified. Part of the challenges expected is the time and cost constraints to update the risk analysis frequently. Moreover, the challenges will be due to the changes made in the operation procedures. Furthermore, major challenge will be from the practices of the management or the plant’s personnel itself.

Particularly, for the qualitative risk analysis, it is expected to obtain result that shows lack of expertise who experts in conducting the operations in oil and gas plant and lead to less accurate estimates used for expert judgment method.

For the quantitative risk analysis, it is expected to identify that there is some wrong calculation or mistakes in documenting the risk level documentation which then brings to less precise and less accurate quantitative risk analysis.

Nevertheless, these expected results may be different in future after this research is completely done. This is because other challenges may be identified or the expected challenges are not present in the real surrounding of the onshore oil and gas plant.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides the overview of previous researches related to the risk analysis conducted for the operation/s in oil and gas plant. The review of the literatures also includes the components such as overview of risk, risk attitude, operations in oil and gas plant, risks related to operations in oil and gas plant, risk analysis for operation/s in oil and gas plant and last but not least barriers for quantitative and qualitative risk analyses. The review of literatures in this chapter enables to provide some information and knowledge as firm source of reference for this research. A literature review permits a researcher to observe and study how the previous research efforts able to be beneficial to the existing degree of knowledge, (Cottrell and McKenzie, 2011).

2.2 OVERVIEW OF RISK

According to Fraser and Simkins (2010), risk is usually defined as the possibilities, opportunities or chances and uncertainty of either results or effect. Relying on this statement, risk is an event which is not yet occurs and has a potential to take place in upcoming time. As explained by Beck (2007), risk can be referred to as the prediction of future devastation and disaster. It is understood that risk involves an estimation of probability of specific condition that can cause harm later if a normal condition is not running as what had been planned in first place. Therefore, the nature of the risk itself is collectively about the possibilities and estimations on any undesirable occurrence due to certain unsafe and harmful situation in a place.

Definition of risk could be either long or short where the long definition of risk is likelihood and level of disaster or an unwanted event and a magnitude of losses whereas risk in short is defined as sort of bad things that could occur in future (Hubbard, 2009). The word risk is labeled and identified as the chance of suffering harm from a danger exposure, (Cohrssen and Covello, 1999). Based on these two definitions of risk, the word risk is determined as the potential of an event to be harmed and related to dangerous and hazardous influence and impact.

In contrast, risk is not restricted to probability of an event only but also determines and refers to values and estimated losses, (Hardy, 2005). Therefore, risk is not only a story about predicting its occurrence but also considering the impact or consequences in monetary aspect. This is because when the risks take place in real circumstances, the related parties or companies need to bear either big or small losses due to the failures or the unwanted things happened. As a result, either much or less, the companies or the parties have to spend some amount of money to fix or control the problem or failure that arises. The cash flows out is considered as the predicted losses and values as mentioned before.

Risk definition and understanding about risk is also depending on the opinion and perspective towards risk. The perceptions towards risk may vary in different ways of interpretation. In most cases, risk is expected to be always a terrible and unwanted event. According to Renn and Rohrmann (2000), risk in most contexts is understood as a danger of undesirable occurrence rather than a chance for obtaining desired results.

Meanwhile, Ramroth and Jr. (2007) pointed that risk usually refers to probability of threats, dangers or unwanted conditions to take place. For that reason, risk is believed to be something which is not planned to get and has potential to occur and will threaten and harm particular item if it occurs. These arguments and viewpoints are actually illustrate that risk is a condition or event which will gives negative and bad impact and effect to one state and is usually shunned and is unpleasant as its possibilities of occurrence can results deterioration consequences.

On the other hand, the term risk is not limited to the negative things only. When a risk could open opportunity and producing good results, the risk can be classified as

positive risk. As pointed by Stoker (2006), risk is not a chance or an opportunity that is to be escaped but in other way round, risk is an opportunity or chance that is cannot be avoided. Based on this statement, one should not keep away from risk as it will always exists in any state or circumstances and when it seems to be beneficial in upcoming time. Furthermore, it is also mentioned that a fresh new opportunity can be created if the right risk is chosen and it is faced in right way. In other words, a particular risk can be a good thing instead of giving bad effect in future if the risk is taken and confronted with right ways.

Risk also can be a fine and positive consequence and future event and necessarily only affect a condition negatively. Risk can be defined in many other ways and the term itself can brings either upside and downside in certain occurrence. Likewise, risk can give advantage when it is considering about the profit or return by which one can gain by taking up the risk, (Leitch, 2008). Thus, risk is can be assumed as a good thing whenever its outcomes associate with prospect benefits and profits.

By referring to the definitions of risks generally, the term is mainly about negative effect and about harms. Nevertheless, risk also can be defined as a good thing and a potential of obtaining positive feedback or outputs when the risk is accepted instead of stay away from it. Hence, there is no exact and finite definition of risk but the definition still about the likelihood and severity of the risk and the way how the word risk is defined depending on the interpretation of the risk itself either optimistic or pessimistic point of view.

2.3 RISK ATTITUDE

Risk attitude is the constitution of risk averse, risk neutral and risk tolerant and risk seeking. Some ideas do include also the risk seeking as one of the risk attitude and some are not. The risk attitudes demonstrate the action and response of a group or of an individual towards risk. In addition, risk attitude is depending on how is the group or the person think and have an idea about risk. The terms averse, neutral, tolerant and seeking are the representative of one’s response to an uncertainty which is considered and is catalyzed by perception towards risk, (Webster and Hillson, 2012).

Generally, risk attitude is about how a person or a group that involves to react and shows their intuitive feeling about the risk they need to face as well as how they are doing in experiencing the risk. As explained by Drummond et al. (2005), if a person keeps away from risky approach and choice, the person is identified as risk averse, if he or she is unresponsive to the risk hence the person is risk neutral while the person is called as risk seeking if risky conditions and states are his or her preference.

Furthermore, Geweke (1992) stated that hypothesis of attitude to risk refers to one's preference to do risky choice and selection method is incorporation of strength of a feeling to the risk and also how his/her response or react to the risk. Based on the hypothesis, one of examples that can be referred to is if the stronger the unpleasant feeling to the risk identified, the stronger the reluctance and the aversion to the risk. This will be similar for other three types of risk attitudes.

Risk reluctance or risk aversion is being noticeable in a situation with less risk, Vertzberger (1998). The reason is it is easier to resist or to keep away from taking up the risk as in low-risk situation, this action towards risk does not giving high impact if the risk is refused or rejected rather than if in a high-risk states or circumstance.

According to Aven and Vinnem (2007), the idea of risk aversion is used to describe an attitude or behavior to risk and uncertainties and it is believed that risk aversion is about disliking and unpleasant feeling towards effects and consequences. Thus, the risk averse can be pointed to a person who has disagreeable feeling and tend to disregard a risk. According to the arguments and statements before, it can be deduced that risk aversion is all about risk avoidance and risk resistance.

Conversely, risk neutral is about a state where a person or a group is indifferent towards risk identified in surrounding. The level of risk aversion and risk acceptance or risk seeking is at same level and not bias to any of these risk attitudes. The risk neutral is definitely about an individual or team which is or are neither avoid nor accept the risk and to an extent, they thinks it is better to draw and formulate strategies that will give profit and advantage in future, (Hillson, 2009).

Nonetheless, as explained by Hillson and Simon (2012), term risk neutral shows a combination of temporary risk aversion and also durable risk seeking. Describing this point

of view, it is understood that risk neutral is a combination of risk aversion and risk acceptance or risk seeking. Unlike the definition of risk neutral before which is stated that risk neutral is about balance level of risk averse and risk acceptance, risk neutral here is perceived as people refuse to take risk for short-term time duration only and after they aware the upside of taking up the risk, their attitude change into looking for the risk.

According to Webb (2000), risk acceptance is referring to an action and to a response of concerning the presence of risk in which the people with this type of attitude have a tendency to acknowledge risk when the risk impact and its possibility to occur are inaccessible and small. Therefore, it is believed that risk can be accepted or can be tolerate if the situation is under control and has very low risk level.

Moreover, as pointed by Hillson (2009), the people with an attitude of risk tolerant will not see a risk as harm thing and accept the risk as a typical and normal thing which has no implication to them. They are either really aware about the risk and try to treat the risk as a thing which is not dangerous or they are actually do not has an exact estimation on the degree of the risk capable to cause destruction in one particular time in future and that is why they are just accepting the risk.

Risk seeking is different with the other behaviors to risk. Risk seeking is all about aiming for high return on investment. Risk seeking is explained as a risky condition and state is faced in order to gain equal or higher expected value in time onward (Kahneman and Tversky, 2000). Once ones have trust and are very confirm that their investment will produce positive outcomes and revenue, they will be willingly to take up and bear the risk as long as they can get what they wish for in prospect.

Hillson (2009) determined that risk seeking as an attitude towards risk by which those who are with this attitude will either misjudge the threats or overestimate the uncertain payoffs and they are not scared to take action. This type of people can be labeled as risk seekers. They are craving for risk or in other words they are always looking for chance and opportunity to gain benefits from some situation although they know the risk that they will and should bear with.

The risk attitudes are important to be determined and understood in order to see people's responses and culture towards risk. By understanding these several types of risk

attitudes, how the risk is faced which is corresponds to the risk perception about risk is identified as well as the ways risk management processes are carried out can be also found out. By having only a general overview about risk, it is insufficiently for ones to understand what are other dimensions of risk can be and how the term risk itself can be diverged in many other specific things.

2.4 OPERATION/S IN OIL AND GAS PLANT

According to Devold (2009), the oil and gas combining networks can be very huge and wide together with thousands well as a source of production from very far distance via a gathering channels into a processing plant. The onshore oil and gas plant is obviously about project of processing and production of products from the crude oil and raw gases extracted from drilling activities at offshore area.

As pointed by Inkpen and Moffett (2011), oil and gas industry is an industry which using very large amount of investment of money and also involve in decision-making of an upstream exploration and development project as well as during a post-development after the upstream development activity complete which is specifically during process of production together with in midstream and downstream sections such as transporting like shipping, pipelines, refining and last but not least range of chemicals. As referring to this statement, oil and gas plants can be classed or consisted of plants of different operations such as for refining and production of chemicals. Besides, the operations in the oil and gas plants for onshore project are not restricted or limited to only production activity.

Likewise, downstream activities are about refining, marketing, processing and also distributing functions, (Wright and Gallun, 2008). As mentioned before, onshore oil and gas plants are not only focusing on operation of production only but also functioning and operating for some other purposes such as refining and processing of crude oil and raw natural gases drilled from offshore sites.

There are several major components of a plant which consist of different sections of processes. The sections are wellheads, manifolds, separation, gas compression as well as some sections for metering, storage and export, (Devold, 2009). These various divisions differ to each other and have dissimilar processes and outcomes. This is to actually differentiate the products and to prevent the operations and procedures to be

mixed up. Yet, with the crucial components that have their respective roles and purpose, this is how downstream operations are functioning.

Last but not least, the operations in oil and gas plant are not narrowed to only production purpose but also can be other type of operations or they also can be a constitution of several types of operations which are specifically categorized and grouped according to the intended principles and outcomes.

2.5 RISK RELATED TO OPERATION/S IN OIL AND GAS PLANT

Before a risk analysis can be carried out, any types of risks in the plant should be identified. By doing this, the risk analysis will be more specific and correlated to the risks. Hence, person or people who responsible in doing the risk analysis as well as all workers in related oil and gas plant should aware all those risks so that no one of the risks are misjudged and misplaced during the analysis and interpretation of the risks.

According to Ayyub (2011), any accident happen in a complex system like offshore and onshore oil and gas processing plant, it will cause large monetary expenses or losses as the accident occur in that kind of risky places can cause the plant to stop its operations and to one extent it also can also hurt people, damage property as well as an environment. The accidents happen as a consequence of some factors which consist of specific risk events and the occurrence of the accidents shows that risks in oil and gas plant are relatively important to beware and identified.

Likewise, as explained by Nolan (1996), oil and gas operations are mostly a type of nonstop operations and yes the industry is upgrading economics but this condition will cause an increasing amount of fuel inventories which then inbuilt risk in that particular operations. Thus, it is believed that operations in the oil and gas plant specifically come along with their respective allied risks and the exposure to the risks is high and risky condition in the plant is always there.

One of risks that can take place in an oil and gas plant is a fire risk. As pointed by Hardy (2005), this type of fire is a risk that has possibility of fire to ignite. Based on the definition, fire risk is also one of the risks in oil and gas plant as it is understood that the plant which operating with the oil and gas materials where most of them are flammable and can be source of fire ignition.

According to Stellman (1998), fire is an expression of uncontrolled burning which involves combustible materials such as in the presence of large amount of gases, liquids and solids that are found in industry. Hence, fire risk is considered as one of risks identified in oil and gas plant as there are wide range of flammable materials which associate with fuels as a product from oil and gas operations.

Other risk that has probability to occur and does exist in onshore oil and gas plants is inspection risk. The Interior's onshore and offshore guidelines for tracking and supporting where oil and gas are measured are not reliable by which Interior tracking offshore measurement points offshore but not for onshore operations and thus creating challenges for onshore staff assigned for inspection job to validate accuracy of the related measurements, (Rusco, 2010). Based on this statement, it is illustrated that an inspection risk is also exist in onshore oil and gas plant. This type of risk associates with the errors made by the staff during conducting inspection procedures. The errors of the measurement outcomes are results from inspection inaccuracy which can be caused by lack of guidelines and appropriate policies.

According to Roberge (2007), the constraint that has to be faced by a corrosion engineer is to have plant inspection workforce with a sound technical understanding of potential deterioration mechanisms for use in developing effective strategy to limit risk of potential equipment failures. Any fault inspection can be one of the risks although inspection is used to find out and determine the possibilities of failures occurrence. This condition can be described as if there are any failures that are miscalculated during the inspection and there are some crucial failures that are given less attention and only few are concerned and well observed. Hence, the inspection itself can be a risk to the operations in oil and gas plant.

Braunschweig and Gani (2002) stated that the most vital issues concerning the operations of revolving machinery such as power generator of gas turbine and compressors and the efficiencies of both of these types of machines are vividly fall at operations which are significantly divert from the design point. This shows that the machinery faulty and deterioration is one of the risks related to the operations in oil and gas plant as the machines are important parts or components in the plant and those machines are considered failed when they are not functioning as planned earlier.